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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Mostafazadeh et al.

Attorney Docket No.:
NSC1P217D2/NS-3877-2

Patent: 6,888,228 B1

Issued: May 3, 2005

Title: LEAD FRAME CHIP SCALE PACKAGE

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first-class mail on June 9, 2005 in an envelope addressed to the Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.

Signed:

Aurelia M. Sanchez

**REQUEST FOR CERTIFICATE OF CORRECTION
OF APPLICANT'S MISTAKE
(35 U.S.C §255, 37 C.F.R. §1.323)**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
Attn: Certificate of Correction

**Certificate
JUN 15 2005
of Correction**

Dear Sir:

Attached is Form PTO-1050 (Certificate of Correction) at least one copy of which is suitable for printing. The errors together with the exact page and line number where the errors are shown correctly in the application file are as follows:

SPECIFICATION:

1. Column 1, line 19, delete "However, as". This appears correctly in the redlined version of the Substitute Specifications as filed on February 2, 2004, on page 1, line 21. It is noted that the clean version of the Substitute Specifications, filed on the same date, inadvertently failed to indicate this deletion.

2. Column 1, lines 38-56, delete "A temporary support fixture provides support and stability to a thin lead frame panel having the fine geometries required for high-density IC chip interfaces. An embodiment of the support fixture includes an adhesive pad made of one-sided sticky tape mounted to a rigid frame made of stainless steel, the rigid frame maintaining the

adhesive pad in a fixed configuration providing a stable flat surface for support of the lead frame panel. Alternatively, the rigid frame and adhesive pad can be made of any materials compatible with the IC package manufacturing process and capable of supporting the lead frame panel through the manufacturing process. The adhesive pad can also be patterned to ease the manufacturing process. The rigid frame can include positioning features to assist in the alignment of the lead frame and adhesive pad. If encapsulant material is to be dispensed over the lead frame panel, a containment dam can be formed around the lead frame after it is installed on the adhesive pad, to provide a boundary for encapsulant material flow". This appears correctly in the redlined version of the Substitute Specification as filed on February 2, 2004, on page 2, lines 4-16. It is noted that the clean version of the Substitute Specifications, filed on the same date, inadvertently failed to indicate this deletion.

3. Column 2, line 17, delete "typical". This appears correctly in the redlined version of the Substitute Specifications as filed on February 2, 2004, on page 3, line 5. It is noted that the clean version of the Substitute Specifications, filed on the same date, inadvertently failed to indicate this deletion.

4. Column 2, line 18, change "ne embodiment" to --one embodiment--. This appears correctly in the Substitute Specifications as filed on February 2, 2004, on page 3, line 6.

5. Column 3, line 49, change "panel 10" to --panel 110--. This appears correctly in the patent application as filed on July 25, 2000, on page 6, line 2.

CLAIMS:

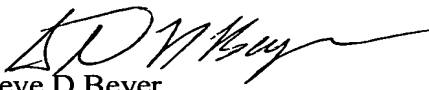
1. In line 2 of claim 14 (column 6, line 30) change "multiplicity ay of" to --multiplicity of--. This appears correctly in Amendment E as filed on February 2, 2004, on page 5, paragraph 4, line 2, as claim 26.

2. In line 3 of claim 16 (column 6, line 54) change "that substantially" to --that are substantially--. This appears correctly in Amendment E as filed on February 2, 2004, on page 5, paragraph 6, line 2, as claim 28.

Patentee hereby requests expedited issuance of the Certificate of Correction. As required for expedited issuance, enclosed is documentation that unequivocally supports the patentee's assertion without needing reference to the patent file wrapper.

Check No. 26424 in the amount of \$100.00 is enclosed in accordance with 37 CFR § 1.20(a). However, if it is determined that any fees are due, the Commissioner is hereby authorized to charge such fees to Deposit Account 500388 (Order No. NSC1P217D2).

Respectfully submitted,
BEYER WEAVER & THOMAS, LLP


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JUN 16 2005



LEAD FRAME CHIP SCALE PACKAGE

Shahram Mostafazadeh

Joseph O. Smith

BACKGROUND INFORMATION

10 Field of the Invention

The present invention relates to integrated circuit packages, and more specifically, to the production of a chip scale integrated circuit package using a lead frame.

15

Related Art

The use of a lead frame provides an inexpensive means for IC package manufacturing. Etching or stamping a sheet of thin metal to produce the desired lead frame patterns is a well-known manufacturing process, and is conducive to high-volume, low-cost production. In addition, the lead frame panel provides a support framework for the IC chips during IC package assembly. However, as Figs. 1d-1 through 1d-3 show examples of common IC packages using lead frames. Fig. 1d-1 shows a small outline package (SOP) 191. Figure 1d-2 shows a pin-through hole (PTH) package 192. Figure 1d-3 shows a plastic leaded chip carrier (PLCC) 193.

25 As IC chip device densities increase and IC package sizes decrease, the geometries used in the electrical communication paths between the IC chip and the PCB decrease. For example, a chip scale package requires that the protective casing be no more than 20% larger than the IC chip. As a result, the area available for the electrical paths provided by the lead frame is significantly reduced, demanding much
30 finer lead frame patterns. ~~In order to construct that finer geometry, the lead frame thickness must be reduced to a point where the lead frame panel rigidity would no longer be sufficient to provide the necessary support during the IC package assembly process. Also, the fragile lead frame patterns would be more susceptible to damage during the manufacturing process. As a result, chip scale IC packages must use more~~
35 ~~costly techniques such as tape automated bonding (TAB) or printed substrate backing.~~ Accordingly, it is desirable to provide an IC packaging method that allows the use of a lead frame in a chip scale package.

SUMMARY OF THE INVENTION

The present invention provides a method for producing chip scale IC packages using lead frames. A temporary support fixture provides support and stability to a thin lead frame panel having the fine geometries required for high density IC chip interfaces. An embodiment of the support fixture includes an adhesive pad made of one-sided sticky tape mounted to a rigid frame made of stainless steel, the rigid frame maintaining the adhesive pad in a fixed configuration providing a stable flat surface for support of the lead frame panel. Alternatively, the rigid frame and adhesive pad can be made of any materials compatible with the IC package manufacturing process and capable of supporting the lead frame panel through the manufacturing process. The adhesive pad can also be patterned to ease the manufacturing process. The rigid frame can include positioning features to assist in the alignment of the lead frame and adhesive pad. If encapsulant material is to be dispensed over the lead frame panel, a containment dam can be formed around the lead frame after it is installed on the adhesive pad, to provide a boundary for encapsulant material flow. In one aspect of the invention, a lead frame panel suitable for use in packaging an array of integrated circuits is described. The lead frame panel includes a matrix of tie bars that extend in substantially perpendicular rows and columns to define a two dimensional array of immediately adjacent device areas separated only by the tie bars. Each device area is suitable for use in an independent integrated circuit package and includes a die attach pad and a plurality of conductive contacts.

In another aspect of the invention, a panel assembly suitable for use in simultaneously packaging a multiplicity of integrated circuits is described. The panel assembly includes a lead frame panel formed from a conductive sheet. The lead frame panel is patterned to define at least one two dimensional array of adjacent device areas. Each device area is suitable for use as part of an independent integrated circuit package and including a die and a plurality of contacts positioned around and electrically connected to the die. A molded cap is also provided that substantially uniformly covers a two dimensional array of adjacent device areas while leaving bottom surfaces of the conductive contacts exposed to facilitate electrical connection to external components. The encapsulation material that forms the molded cap is

exposed at a bottom surface of the panel of integrated circuits to physically isolate the contacts.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Fig. 1a shows a representation of a ~~typical~~ lead frame panel in accordance with one embodiment of the present invention;

 Fig. 1b shows [a] the lead frame panel of Fig. 1a populated with IC chips;

 Figs. 1c-1 and 1c-2 ~~shows~~ show bottom and cross sectional views of a single leadframe BGA IC package in accordance with another embodiment of the present
10 invention;

 Figs. 1d-1 through 1d-3 ~~show~~ shows examples of common IC packages;

 Fig. 2a shows an embodiment of a rigid support fixture;

 Fig. 2b shows a lead frame panel mounted on an embodiment of a support
fixture;

15 Figs. 3a and 3b show a flow diagram of a manufacturing process using a temporary support fixture.

 Use of the same reference number in different figures indicates similar or like elements.

20 **DETAILED DESCRIPTION**

 Generally, an integrated circuit (IC) package encapsulates an IC chip, or die, in a protective casing and also provides power and signal distribution between the IC chip and an external printed circuit board (PCB). A metal lead frame can be used to provide the electrical paths for that distribution. A lead frame panel suitable for use in
25 accordance with the present invention is illustrated in Fig. 1a. For production purposes, a lead frame panel 110 made up of multiple lead frames 120 is etched or stamped from a thin sheet of metal, as shown in Fig. 1a. An IC chip 130 is then mounted and wire bonded to each lead frame 120, as shown in Fig. 1b. Wire bonding is typically performed using fine gold wires 140. As illustrated in Fig. 1c, each IC
30 chip 130 is then encapsulated in a protective casing 160 which may be formed by dispensing and molding a layer of encapsulant material over all IC chips 130. Next lead frames 120 are cut apart, or singulated to produce individual IC packages 190.

surface of frame 210 and provide an adhesive surface for mounting of lead frame panel 110, without requiring additional attachment materials or components. Pad 220 can also be patterned by removing selected portions in order to facilitate subsequent assembly operations such as electrical interconnection formation. Removal of pad 220 once packaging is complete can be performed in various ways, depending on the nature of the adhesive material used. A light adhesive material may allow pad 220 to simply be peeled away from frame 110. An alternative bonding agent requires exposure to UV light before removal of pad 220 can take place.

Figs. 3a and 3b show a graphical flow chart illustrating a method for manufacturing a lead frame BGA package using an embodiment of the present invention. The manufacturing process is described in conjunction with the elements described in Figs. 2a-2c. In a step 310 in Fig. 3a, adhesive pad 220 is applied to rigid frame 210 to create support fixture 200. Lead frame panel 110 is then mounted on pad 220 in a step 320. An optional step 330 allows encapsulant dam 240 to be applied around the border of lead frame panel 110 if subsequent encapsulant material dispensing is to be performed. Next, an IC chip 130 is mounted and wire bonded onto each of the lead frames 120 of lead frame panel 110. Continuing the process in Fig. 3b, a step 350 involves dispensing a portion of encapsulant material 170 into the area defined by dam 240 to cover IC chips 130, and then curing material 170 to a desired hardness. In a step 360, pad 220 is removed from lead frame panel 110. Next, in a step 370, a wafer saw operation is performed to singulate lead frame panel 110 into individual IC packages. The singulation process converts the layer of hardened encapsulant material 170 into individual protective casings 160. Finally, in a step 380, solder balls 150 are applied to

23. (Previously Presented) A packaged integrated circuit formed by singulating the panel assembly recited in claim 22, wherein the conductive contacts in the packaged integrated circuit do not extend beyond the edge of the encapsulation material in the packaged integrated circuit and the die attach pad in the packaged integrated circuit is exposed.

24. (Previously Presented) A packaged integrated circuit as recited in claim 23 wherein the conductive contacts and the die attach pad are substantially the same thickness.

25. (Previously Presented) A panel assembly as recited in claim 22 further comprising an adhesive tape adhered to a bottom surface of the lead frame panel, whereby the adhesive tape serves to keep the exposed surface of the exposed encapsulation material substantially co-planar with the bottom surfaces of the contacts and die attach pads.

26. (Currently Amended) A panel assembly suitable for use in packaging a multiplicity an array of integrated circuits simultaneously, the panel assembly having top and bottom surfaces and comprising:

a lead frame panel formed from a conductive sheet, the lead frame panel being patterned to define at least one two dimensional array of adjacent device areas, each device area being suitable for use as part of an independent integrated circuit package and including a die and a plurality of contacts positioned around and electrically connected to the die; and

a molded cap that substantially uniformly covers the two dimensional array of adjacent device areas while leaving bottom surfaces of the conductive contacts exposed to facilitate electrical connection to external components, wherein encapsulation material that forms the molded cap is exposed at a bottom surface of the panel of integrated circuits to physically isolate the contacts.

27. (Previously Presented) A panel assembly as recited in claim 26 wherein:
each device area in the lead frame panel further includes a die attach pad; and
bottom surfaces of the die attach pads are also exposed.

28. (Currently Amended) A panel assembly as recited in claim 27 wherein the die attach pads and the conductive contacts each have upper and lower surfaces that ~~and the tie bars~~ are all substantially co-planar.

(Also Form PT-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE CERTIFICATE OF CORRECTION

PATENT NO. : 6,888,228 B1

DATED : May 3, 2005

INVENTOR(S) : Mostafazadeh et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Specifications:

Column 1, line 19, delete "However, as".

Column 1, lines 38-56, delete "A temporary support fixture provides support and stability to a thin lead frame panel having the fine geometries required for high-density IC chip interfaces. An embodiment of the support fixture includes an adhesive pad made of one-sided sticky tape mounted to a rigid frame made of stainless steel, the rigid frame maintaining the adhesive pad in a fixed configuration providing a stable flat surface for support of the lead frame panel. Alternatively, the rigid frame and adhesive pad can be made of any materials compatible with the IC package manufacturing process and capable of supporting the lead frame panel through the manufacturing process. The adhesive pad can also be patterned to ease the manufacturing process. The rigid frame can include positioning features to assist in the alignment of the lead frame and adhesive pad. If encapsulant material is to be dispensed over the lead frame panel, a containment dam can be formed around the lead frame after it is installed on the adhesive pad, to provide a boundary for encapsulant material flow".

Column 2, line 17, delete "typical".

Column 2, line 18, change "ne embodiment" to --one embodiment--.

Column 3, line 49, change "panel 10" to --panel 110--.

In the Claims:

In line 2 of claim 14 (column 6, line 30) change "multiplicity ay of" to --multiplicity of--.

In line 3 of claim 16 (column 6, line 54) change "that substantially" to --that are substantially--.

MAILING ADDRESS OF SENDER:

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